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Simulation Model Development for Mail Screening Process

Presentation to the 73rd MORS Symposium
Working Group 28 – Decision Analysis

Decision Analysis Team
Edgewood Chemical Biological Center

21-23 June 2005



Objective

Describe and receive feedback on the development of the simulation model and future model modifications.



Outline

- Study Objective
- Background
- Problem Definition
- Model Development
- Processing Scenarios
- Value Added
- Future Model Modifications
- Lessons Learned



Study Objective

Provide Decision Analysis support to the Homeland Defense Business Unit: Special Projects Team in developing a simulation model to help determine the most effective way to eliminate backlog, estimate when backlog will be eliminated, and to analyze current processing procedures.



Background

- Procedures developed to monitor, detect and identify contaminated mail for chemical, biological, radiological, nuclear and explosives (CBRNE)
- Mail processing procedures include arrival, sorting, inspecting, examining and distributing
- Increase in daily incoming volume exceeded facilities processing capability and resulted in the creation of backlog



Problem Definition

Initial Objective

- Determine tradeoffs between storage options and additional processing associated with each storage option

Storage

- Refurbished building
- Commercial Storage
- Concrete pad
- Trailers

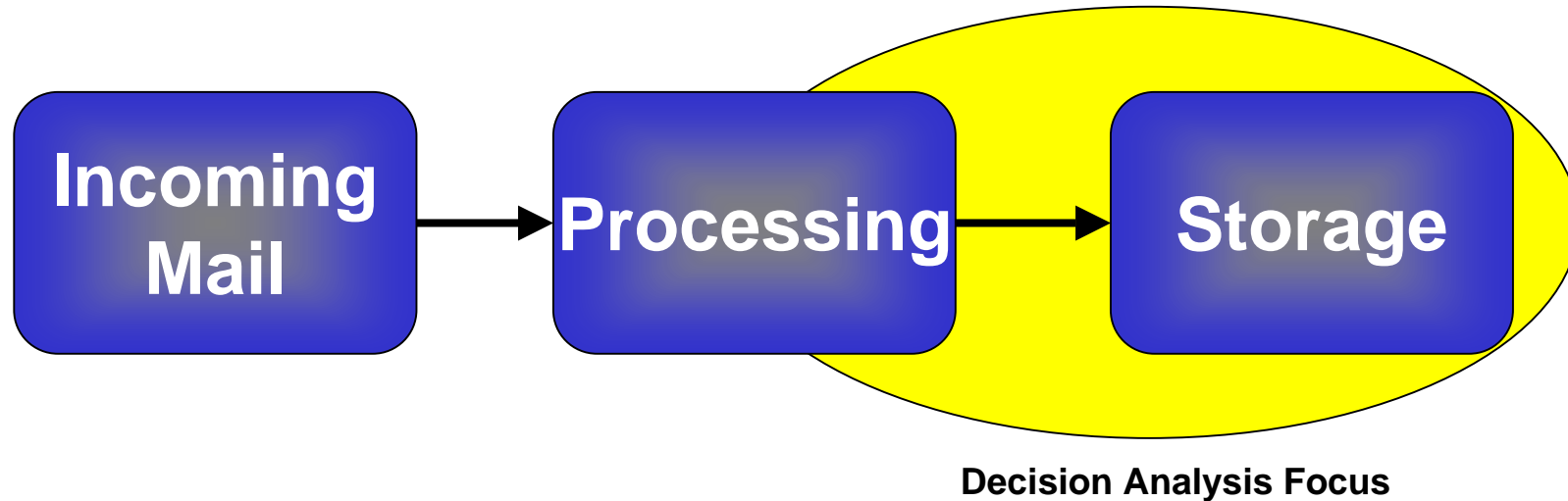
Processing

- Additional shifts
- Expand current facility
 - Inside
 - Outside
- Refurbished building
- New pole building
- Concrete pad
- Existing building



Problem Definition

Initial Model Structure



- High level model
- Determining the most cost efficient storage option
- Tradeoffs between storage and processing options



Problem Definition

Issues

- High level model
- Lack of validated data to populate model
- Storage options address only one aspect of problem
- More detailed processing options were required



Problem Definition

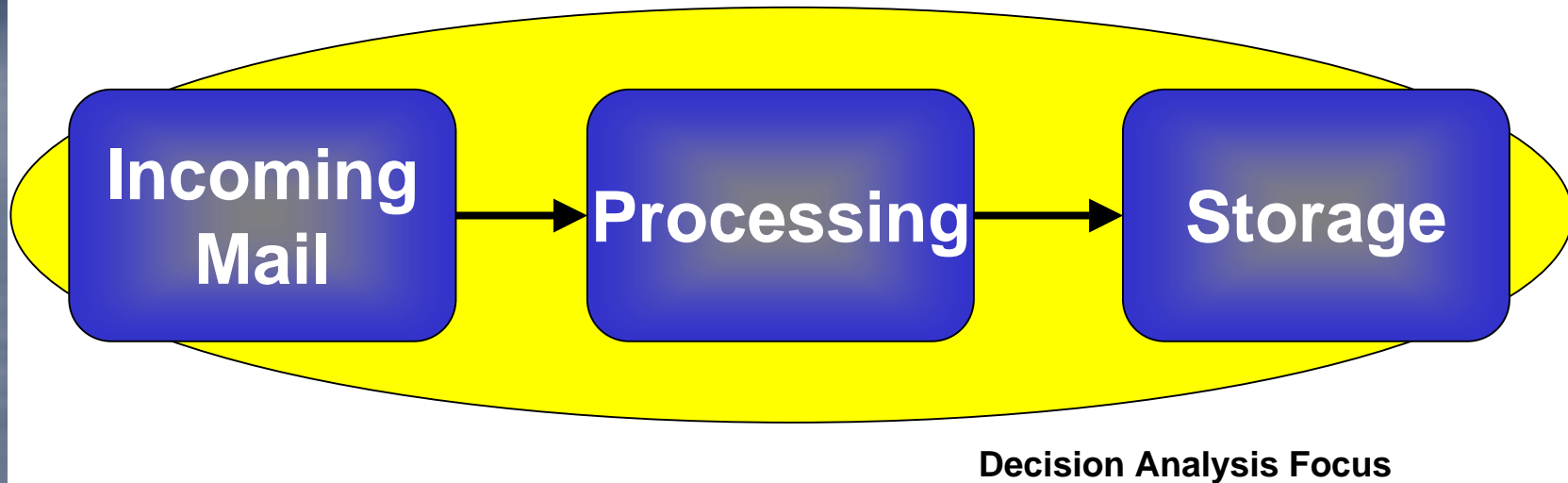
Revised Objectives

- Modify Phase 1 simulation model to include entire process (incoming, processing and storage)
- Determine the effect on backlog of various “what-if” scenarios.
 - Modify the number of processing stations, shift hours, work days, etc...
 - Determine the backlog elimination date (by priority)



Problem Definition

Revised Model Structure



- Phase 2 increased focus to include the entire process; however it is still a high level model



Model Development

Approach

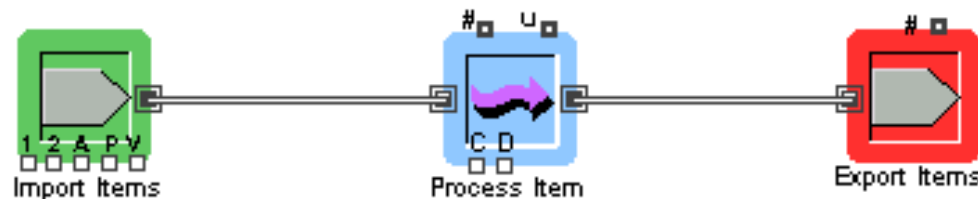
- Requirements Gathering
- Model Build and Modification (continuous)
- Data Collection (continuous)
- Verification Meeting
- Validation Meetings
- Scenario Development Meetings



Model Development

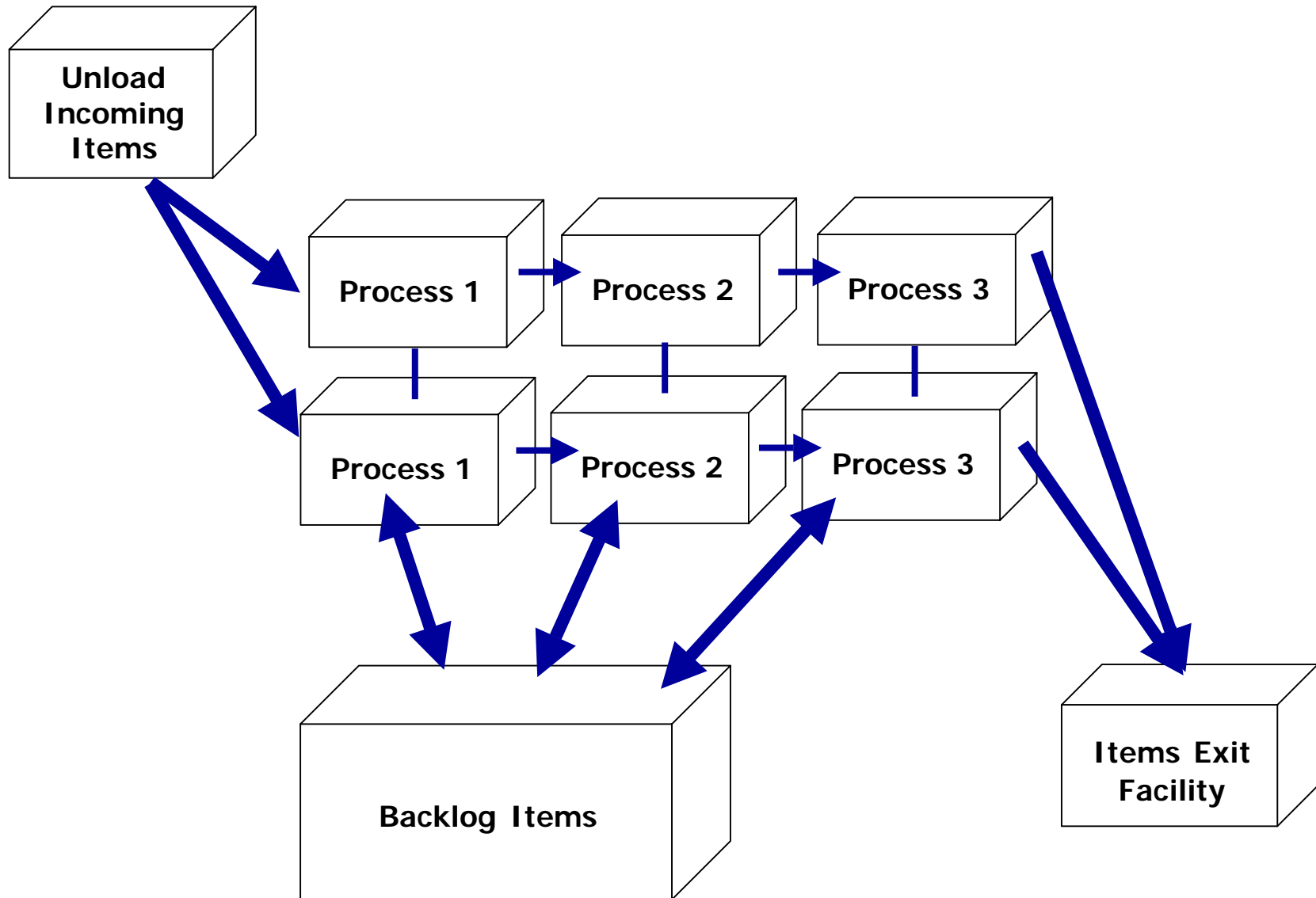
Modeling Tool

- Extendv6
- Commercial off the shelf software package
- Blocks are the basic building components
- Expansive library of code representing process components
- Model built by positioning and connecting blocks into the proper sequence (drag and drop modeling)



Model Development

Model Detailed Structure



Model Development

Assumptions

- Processing stations are operated by two employees 75% of the time and by one employee 25% of the time
- As long as there is backlog, it is assumed that employees always have work
- Data collected by on-site contractors
- Time Study performed by consultant



Model Development

Data Collection

- Worked one-on-one with customer to identify important data elements and estimated data points
- Analyzed monthly processing data
- Determined additional data needed and provided input in development of data collection template
- Analyzed time study data



Model Development

Distribution and Probability Data

- Random distributions and probabilities:
 - Arrival of daily incoming items
 - Variations in monthly incoming volume
 - Seasonal variations
 - Mail to be processed vs. misdirected/junk
 - Type and number of items entering facility
 - Processing station and facility shutdowns



Model Development

Operational Data

- Operational Decisions:
 - Assignment of priority to items in backlog
 - Scheduled facility closure
 - Shift schedules
- Source Data:
 - Processing Data Summaries (Jul 03–Mar 05)
 - Unusual Event Data (Mar 03–Mar 05)
 - Time Study



Model Development

Verification and Validation

- Uncoupled the blocks of code to verify the model operates as expected
- Verified model with consultants and industrial engineers to ensure model included the appropriate aspects of the operation
- Removed probabilities and distributions and ran model with actual data to validate that the model results correlate with operational results



Model Development

Scenario Development Meetings

- Worked with customer to identify scenarios
 - Backlog elimination (by priority)
 - Number of processing stations needed to eliminate backlog by a specific date
 - Maximum output
 - Processing stations utilization rates
- Develop “what-if” scenarios



Processing Scenarios

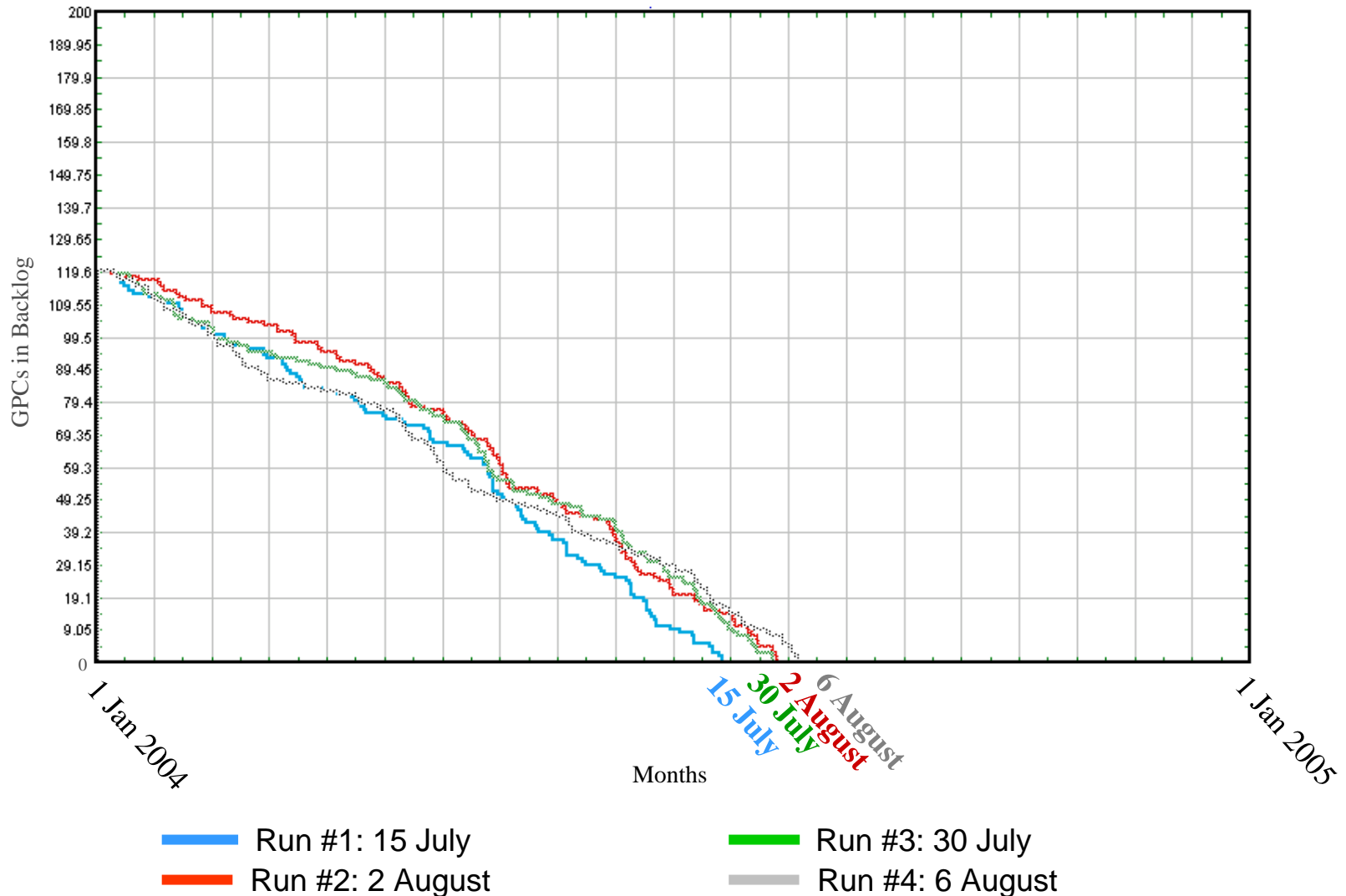
Example Scenario

- Scenario Objectives:
 - Estimate backlog elimination date
 - Determine effect of 4 additional stations in June
 - Estimate backlog elimination by priority
- Model Run:
 - Model run start - January 2004
 - Current backlog 120 General Purpose Containers
 - 8 - processing stations
 - 2 - 6.5 hour shifts



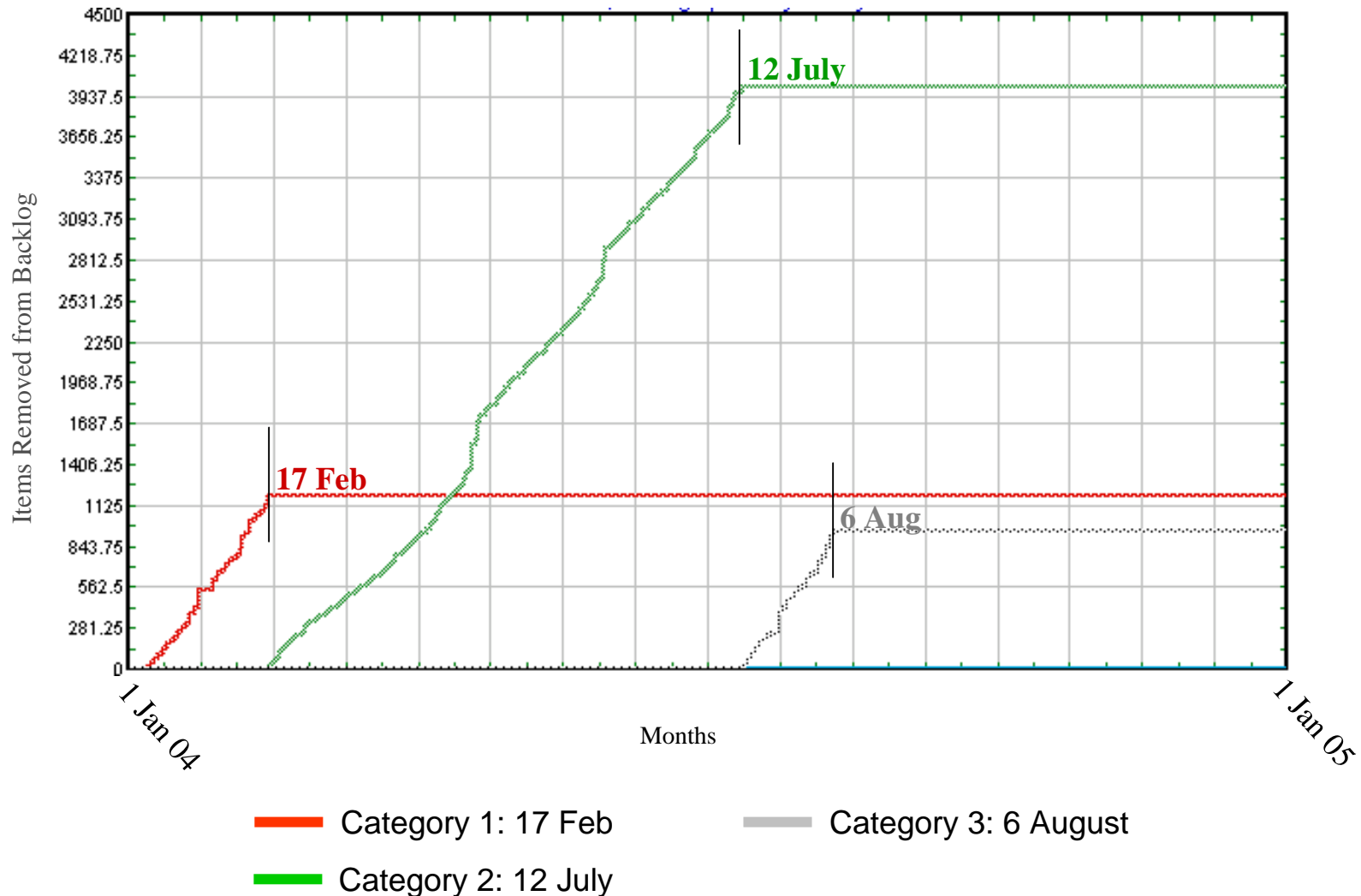
Processing Scenarios

Estimated Backlog Elimination Date



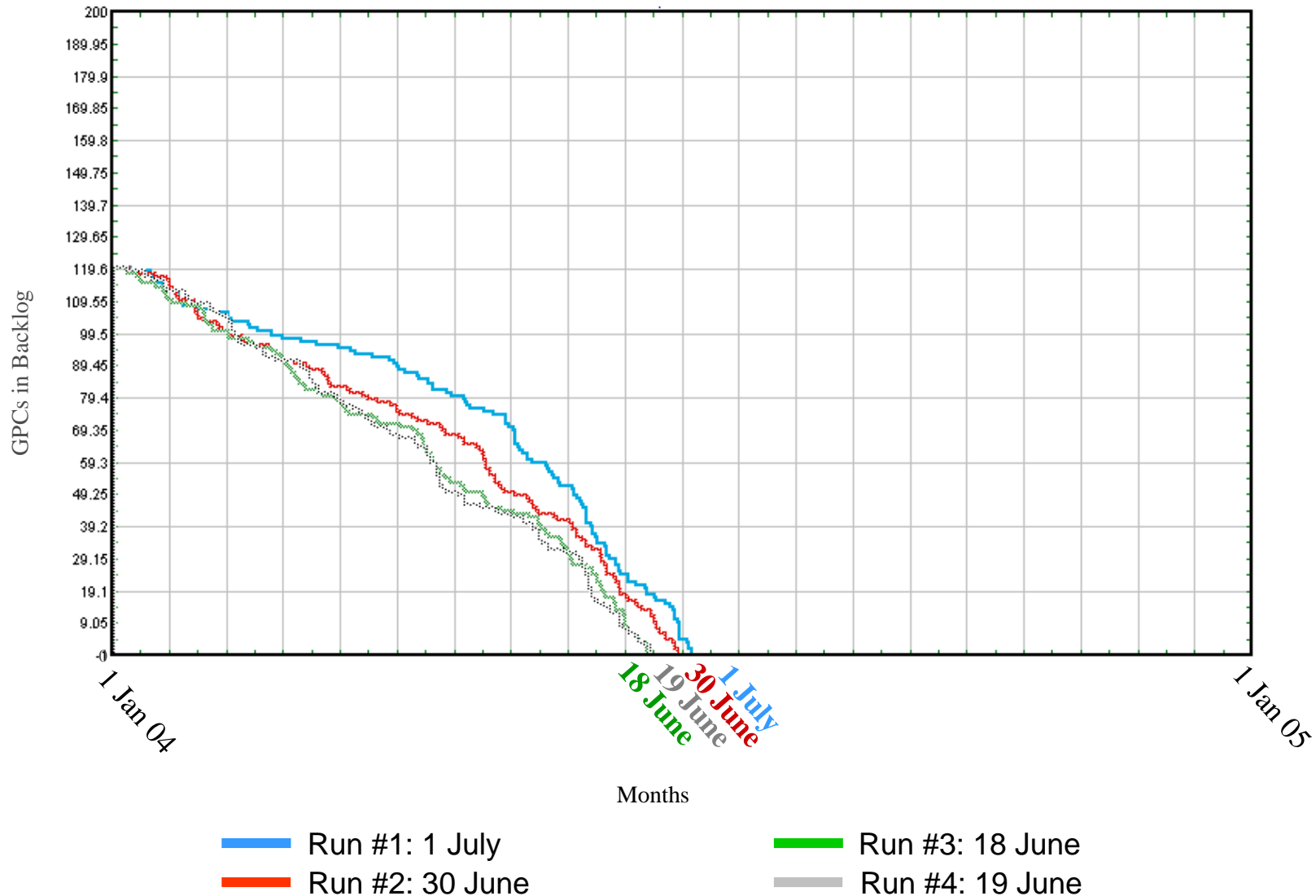
Processing Scenarios

Estimated Backlog Elimination Date by Priority*



Processing Scenarios

Effect of 4 Additional Processing Stations



Processing Scenarios

Example Scenario Results

- Estimated backlog elimination date: July-August*
- Estimated backlog elimination date with 4 additional station in June: June-July*
- Estimate backlog elimination by priority:
 - Results from model run #4:
 - Category 1: February
 - Category 2: July
 - Category 3: August
- Actual backlog elimination: Week of July 27



Value Added

- Planning tool
 - Determine most effective processing options prior to implementation
- Cost/Benefit analysis
 - Determine cost/benefit relationship of processing options prior to implementation



Future Modeling Effort

Objectives and Modifications

- Advanced model development
 - Increased level of detail
 - Detailed interactions among operational resources
 - Customizable modules
- Interactive planning tool
 - Reduce inefficiencies, prevent bottlenecks and develop contingency plans
 - Daily production planning
- Marketing tool
 - Visualization of customizable processing facility



Lessons Learned

- Data collection is critical
 - Data collection is a continuous process
 - As model/scenario complexity increases, additional data needs to be collected
- Process continuously evolves
 - Requires regular model updates/modifications to ensure accurate results
- Management support is vital



ECBC

Questions?

